

# SWAS

## Submillimeter Wave Astronomy Satellite

### Mission Objective

The Sub-Millimeter Wave Astronomy Satellite (SWAS) scientific objectives are to study the chemical composition, energy balance and structure of interstellar clouds, and the processes that lead to the formation of stars and planets. The SWAS will focus on spectral lines at the frequencies indicated: 1) water molecule at 556.936 GHz, 2) oxygen molecule at 487.249 GHz, 3) Chlorine molecule at 492.161 GHz, 4) carbon-13 monoxide molecule at 550.927 GHz, and 5) oxygen-18 water molecule at 548.676 GHz. Galactic interstellar clouds (e.g., Orion, Taurus, Ophiuchi, and Perseus) and extragalactic sources (e.g., Magellanic Clouds) will be studied. Detailed 1 degree x 1 degree maps of at least 20 giant molecular and dark cloud cores will be obtained from a grid of measurements taken at 3.7-arcminute spacings.

TYPE OF MISSION	PROGRAM OFFICE	PROJECT LEAD CENTER	MANAGEMENT APPROACH	S/C CONTRACTOR	I&T CONTRACTOR
ASTROPHYSICS	SPACE SCIENCE & APPLICATIONS	GSFC	IN-HOUSE	GSFC IN-HOUSE	GSFC IN-HOUSE

### Payload Description

The Sub-Millimeter Wave Astronomy Satellite (SWAS) instrument consists of an antenna system which is a 54.4 x 67.1-cm elliptical off-axis Cassegrain with a beam width of 4 arcmin at operating frequencies and two receivers: a) a pair of passively cooled submillimeter radiometers which are sub-harmonic Schottky diode receivers and b) an Austo-Optical Spectrometer (AOS) provided by the University of Cologne. The outputs of the two receivers are combined into a final intermediate frequency that extends from 1.4 to 2.8 GHz and is dispersed into 1400 1-MHz channels by the AOS. The SWAS spacecraft is designed to support pointed observations that are stabilized on three axes, with a position accuracy of about 38 arcsec, and fitter of about 24 arcsec. Attitude information is obtained from gyros whose drift is corrected via star tracker data.

INSTRUMENT NAME	ACRONYM	PI AFFILIATION	PRINCIPAL INVESTIGATOR	I&T CONTRACTOR
SWAS INSTRUMENT	NONE	SAO	TBD	SAO
ACOUSTO-OPTICAL SPECTROMETER	AOS	N/A	NONE	UNIV COLOGNE
ANTENNA TELESCOPE	NONE	N/A	NONE	BASG
SUBMILLIMETER WAVE RECEIVER	NONE	N/A	NONE	MILLITECH CORP

Instrument Descriptions
<p>The SWAS Instrument consists of three subsystems: 1) Antenna Telescope, 2) Submillimeter Wave Receiver, and 3) Acousto-Optical Spectrometer (AOS). The Antenna Telescope is a 54.4 x 67.1 cm diameter of-axis Cassegrain beryllium mirror which, along with its associated subsystem, focuses the radiation into the Submillimeter Wave Receiver. The Submillimeter Wave Receiver consists of a pair of cooled subharmonic Schottky diode receivers, which produce intermediate frequencies that are fed into the broadband AOS. The AOS, in turn, permits observations of four spectral lines produced by H<sub>2</sub>O, O<sub>2</sub>, C<sub>1</sub>, and <sup>13</sup>C<sub>18</sub> simultaneously. An additional isotropic species of water can be observed by retuning one of the Submillimeter Wave Receivers.</p>
<p>The SWAS AcoustoOptical Spectrometer (AOS) employs a redundant set of diode lasers and charge-coupled detector (CCD) arrays for space operation. The AOS includes a shear-wave Bragg cell which rotates the polarization of the diffracted beam and a polarizer which is placed before the CCD array. This minimizes detection of stray light and laser speckling, thereby enhancing performance of the AOS during sensitive radiometric operation. The outputs of the Submillimeter Radiometer receivers are combined to form a final IF which is dispersed into 1450 one-MHz channels extending from 1.4 to 2.8 GHz.</p>
<p>The SWAS Antenna Telescope is a 54.4 x 67.1 cm elliptical off-axis Cassegrain with an approximately 4 arcmin beam at the operating frequencies of its submillimeter receivers. The telescope primary mirror (f/0.5 x f/0.4) is fabricated from beryllium. The telescope is rotated in two axes in order to obtain reference positions up to 3° from the observing position. This nodding scheme takes advantage of the baseline performance of an off-axis telescope by assuring that the same optical paths are viewed by the receiver in the off-position as in the on-position. The telescope will dwell on the off-on positions for up to 45 seconds, with up to 15 seconds to perform the nodding maneuver.</p>
<p>The SWAS Submillimeter Wave Receiver consists of a pair of cooled subharmonic Schottky diode microwave radiometer receivers, passively cooled to approximately 150 Kelvin to achieve receiver noise figures of 2500 - 3000 Kelvin (single side band) at the operating frequencies. Local Oscillator power is obtained by frequency tripling the output of the solid-state Gunn oscillators to one-half the frequency of the receivers during subharmonic operation.</p>

Launch
7/13/92(SPX)
6/15/95(SWS)
7/15/95(FST)